Supplementary analysis of stability assessment of dip slopes using a fracture model

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Dip-slope landslides frequently cause large-scale hazards. The benchmark approach to stability assessment of dip slopes adopts a limit equilibrium method (LEM) that considers the slope mass as rigid. Therefore, failure anywhere on the potential plane would occur at one time, i.e., the stress conditions are identical throughout on the failure plane. However, a progressive movement of slope mass is evident, as indicated by the development of tension cracks near the slope crest. The slope stability prior to this type of global failure cannot be estimated by LEM. This study proposes a fracture model for supplementary analysis to evaluate the stability of dip slopes. The characteristics of a dip slope with jointed bedrock fracture parameters are considered, and the factor of safety is redefined using a fracture mechanics approach. Accordingly, the local failure in the rock slope is represented by the weakness of the bedding interface, which fulfills the progressive process of inherent fracturing before global slope failure.
In this study, the influences of geometry and material properties on the driving force of a dip-slope landslide were first discussed by a series of sensitivity analyses. The safety factors evaluated in this study were then compared with those obtained by LEM. Finally, the critical joint persistence was obtained using back analysis, indicating the threshold value of reduction of the rock-material property. The internal crack growth is sufficient for slope instability, so the slope mass detaches from the failure plane. These findings can complement conventional dip-slope stability analyses.

Keywords: slope stability, dip slope, fracture mechanics

